

"RESOURCE RECOVERY FROM SPENT POTLINING"

**JOINT ALCAN/ANACONDA
"PRE PHASE ONE STUDY"**

**MONTREAL
TUSCON**

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In considering the nature of the unit processes which would be required in any treatment plant, it was decided that a minimum capacity of four tonnes per hour would be appropriate. This would equate to an annual capacity in the order of 30,000 tonnes. Another consideration is that the unit processes most likely involved do not lend themselves to intermittent operation. Therefore two different operating procedures were considered, continuous operation if 30,000 tonnes are available or an operating campaign for say 2 - 3 months if annual generation is less (5000 - 6000 tonnes).

4.1.3 - Typical Potlining Analysis

Waste potlining comprises a mixture of carbonaceous matter impregnated with electrolyte plus the cell insulation portion which also contains electrolyte. The material is very heterogeneous, and as such an analytical nightmare. For the purposes of the study the typical composition shown in Table II provided by Alcan was used. It is a representation of the overall fraction (carbonaceous matter plus insulation).

4.2 Criteria for Evaluation of Alternatives

During the early part of this study, it was agreed that an environmentally acceptable spent potlining disposal method, with no recovery of chemicals, should be the base case for comparison with processes which recover chemical values. The following criteria were used for the base case:

1. Above grade, clay and gravel lined, hazardous waste landfill with leachate collection and treatment facilities.

TABLE IITYPICAL POTLINING COMPOSITION

	<u>Range (%)</u>	<u>Typical (%)</u>
NaF	5.0-21.0	11.0
Na ₃ AlF ₆	10.0-25.0	16.0
Carbon	20.0-60.0	30.0
Al ₂ O ₃	9.0-24.0	19.0
SiO ₂	0.7-10.0	5.0
Na ₂ CO ₃	0.3-8.0	4.1
NaAlO ₂	1.0-8.0	5.0
Na ₂ SO ₄	0.3-1.5	0.5
CaF ₂	0.9-4.4	4.0
Fe ₂ O ₃	0.4-1.7	1.2
MgF ₂	0.2-1.0	0.3
Al ₄ C ₃	1.5-6.0	3.0
CN	40-100 ppm	70.0 ppm

Elemental Composition

	<u>%</u>
F total	15.8
Na total	14.5
Al caustic extractable	6.3

2. Disposed potlining covered with clay.
3. Run-off from the disposal site treated for fluorides and cyanides. The acceptable fluoride and cyanide concentrations in effluent: 30 ppm and 0.1 ppm respectively.
4. To minimize the leaching and run-off, spent potlining stored temporarily in a building, prior to moving to the disposal site during the dry season.
5. Monitoring wells provided.
6. The disposal site closed with a cap of topsoil seeded with a native vegetative species.

The potlining disposal method at the Anaconda Columbia Falls smelter with additional treatment facilities for run-off is considered as the base case for cost comparison. Treatment of the effluent with lime and calcium chloride for fluorides and with an oxidation process for cyanide to be included (not practised by Anaconda).

Kepner-Tregoe decision analysis method⁽¹⁾ was used to evaluate the different processes for the recovery of chemicals from spent potlining. This required the establishment of a set of objectives for the study. The objectives were then classified into "MUST" and "WANT" categories. The MUST objectives screen out the impossibilities or non-starters and reduce the number of possible alternatives to a relevant few. The WANT objectives were then classified in the order of importance by assigning each objective a weight on a scale of 1 to 10, the most important WANT objective getting the weight of 10. The relative weight, assigned to each objective, was based on the

(1) "The Rational Manager", Second Edition 1976. Kepner Tregoe Inc. Princeton, N.J.

experience of the Joint Study Group. Each alternative was next scored against each one of the objectives on a scale of 1 to 10. The alternative which best satisfied the objective received a score of 10. Where there was no apparent difference in the performance of two alternatives against an objective, both were assigned the same score. Again, the Joint Study Group's judgement was used in scoring the alternatives. The score of each alternative was then multiplied by the assigned weight giving a weighted score. The weighted scores were added up to give totals which show the relative position of each of the alternatives. The MUST and WANT objectives as well as the relative weight assigned to each of the WANT objectives for evaluating the different processes are given in Table III.

4.3 Possible Processes

All known potentially available processes for the treatment of spent potlining were included in the evaluation. These processes are presented in the following three references:

1. "Technical Review of Potentially Available Technologies for the Treatment of Spent Aluminum Potlining" Anaconda Aluminum Company Report No. 81-23, October 1981 by J.B. Snodgrass.
2. "Treatment of Spent Potlinings - Comparison of Processes Currently Being Employed" European Primary Aluminium Association Report, July 1978 by G. Duprat and D.C. Menegoz.
3. "Summary Tabulation of Used Potlining Methods" Aluminum Company of Canada, October 1977 by D. Fern and B. Gnyra.

The forty different processes were evaluated on their abilities to meet the MUST criteria adopted for this investigation. Twenty-seven were rejected because they did not satisfy the MUST criteria. Of the remaining thirteen, six are under active investigation by other researchers. Although these processes are considered to have some

TABLE III

CRITERIA FOR EVALUATION OF POTLINING PROCESSING ALTERNATIVES

MUST

1. All process effluents meet all environmental regulations.
2. The totally absorbed costs be less than or equal to the present absorbed costs* of potlining disposal.

WANT

	<u>Weight</u>
1. Best overall economics.	10
2. Recovery of a significant portion of the chemical (e.g. fluoride) values in a form suitable for recycle to the pots.	9
3. Plant specific (5000 t/y potlining)	9
4. Treat all materials within the steel shell without materials separation (excluding collector bars).	8
5. Commercial by 1985	7
6. Ease of residue disposal.	6
7. Able to process industry range of potlining.	5
8. Easily integrated into operating plant.	3
9. Marketing potential.	2

*

Present absorbed costs include capital and operating expenditures for opening, filling and closing the site; treatment of the leachate run-off; and post-closure monitoring of the site for ground water contamination.

potential for future success, it was decided that it would be sufficient to monitor the progress of these investigations. The six processes to be monitored are:

1. Battelle's Molten Salt Recovery
2. Kaiser's Pyrohydrolysis
3. Elkem's Pyrohydrolysis
4. USBM's Fluorspar Substitution in Ironmelting and Basic Oxygen Steelmaking
5. Fluid-Bed Incineration
6. Cement Production

This left the following seven mutually exclusive processes as meeting the MUST criteria:

1. Showa Light Metal Company Disposal Process
2. Anaconda 116 Process
3. Alcan Mini-L
4. Alcan-D
5. Nepheline-Soda-Limestone Sinter
6. Sumitomo Aluminum Alum Process
7. Alcan Distillation/Pyrohydrolysis

These were subjected to Kepner-Tregoe Decision Analysis regarding their ability to meet the WANT criteria adopted for this study. The results are presented in Table IV.